SEWER SYSTEM DESIGN CHAPTER

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SEWER SYSTEM DESIGN CHAPTER

1.0 SEWER SYSTEMS

1.1 General

This chapter of the Brunswick Design Manual outlines the policies, minimum design criteria and design procedures for the preparation of feasibility reports and construction plans and specifications for City-maintained and on-site sewer system improvements. Developers and/or Design Engineers shall check with the City Public Works, City Engineer, and Office of Planning and Zoning to determine the availability of sewer at the site of a proposed subdivision. In the event a conflict exists between the requirements, the more stringent applies.

1.1.1 City Policy

a. City-Maintained Facilities

The parts of the sewer system which are considered as the property and responsibility of the City of Brunswick are the sewer mains, pump stations, appurtenances and that portion of the sewer services which lie between the City's rights-of-way. The sewer collection and treatment system for Brunswick is maintained by the City of Brunswick.

b. On-Site Facilities

The parts of the sewer services which lie within private property are the responsibility of the owner and are constructed and maintained by the Owner. Construction of private sewer facilities is generally governed by the Frederick County Plumbing code.

c. Requirements for Sewer Service

1. All properties will be connected to the sewer system of Brunswick.

(a) Each building shall be serviced by a separate sewer tap.

(1) Multiple dwelling units such as an apartment dwelling, duplex or residential unit with apartment(s) may be serviced by a single sewer tap.

(b) If an additional building is constructed on an existing lot which has a sewer tap, the new structure must be provided

with an additional sewer tap.

(c) If a lot containing more than a single structure is subdivided to provide separate lots for each structure, the lot(s) without sewer tap(s) must provide these taps as a condition of subdivision.

(d) If a lot containing a single structure is subdivided, each structure erected upon the new subdivided area must procure a sewer tap prior to obtaining a building permit.

d. All public and private sanitary sewer lines shall be inspected by the City of Brunswick, in accordance with City Inspection Procedures and the City Water & Sewer Rules & Regulations, at the expense of the developer.

1.1.2 Definitions

a. Collector sewer: A sewer constructed within developments which transports sewage to an interceptor sewer.

b. Interceptor sewer: A sewer designed to collect sewage from several developments and transport wastes to a treatment plant.

c. House or building connection (SHC): A sewer which connects a house or other building to a collector sewer. The portion within the public right-of-way is owned and maintained by the City. The portion beyond the right-of-way is owned and maintained by the property owner.

d. Force main: A sewer which conveys sewage from a pumping station to a treatment plant at a higher elevation or to a higher elevation in the sewer from which gravity flow may resume.

e. Manhole: A structure providing access to buried sewer, valve, conduit, etc.

f. Average Daily Flow: The arithmetic sum of the average daily domestic flow plus the average daily commercial flow plus the average daily industrial flow plus any other average daily flow from the service area. The average daily commercial, industrial and other flows shall be based on the period in which these flows are generated.

g. Peaking Flow: The average daily domestic flow peaked in accordance with the curve entitled “Diagram for Converting Average Daily Domestic Flow to Peak Flow” (in the Appendix).

Peak commercial or industrial flow is the average daily commercial or industrial flow peaked in accordance with a factor determined by evaluation of historical data for the commercial or industrial facilities and the periods in which these flows are generated.

The average daily domestic flow, average daily commercial flow, and average daily industrial flow may be peaked individually or combined and then peaked using the curve (in the appendix) as dictated by the evaluation of the sources and periods in which the flows are generated.

Whenever forced flow applies, peak flow shall be equivalent to the pumping rate.

h. Infiltration and Inflow: For design purpose, the upper limit of allowable infiltration and inflow within the areas of the project is 400 gallons per acre per day (gpad). Additional allowance for infiltration and inflow may be made upon verification of evidence or approval of operation data.

i. Design Hydraulic flow: Design Hydraulic flow = Peak Flow + Peak Commercial flow + Peak Industrial Flow + Infiltration and Inflow Allowance.

j. Design Professional: An individual, partnership, or corporation licensed under the laws of the State of Maryland to practice as an engineer, architect, landscape architect, land surveyor or property line surveyor who is preparing contract drawings and documents for a construction project in Brunswick. It shall be the responsibility of the design professional to ensure that the various elements of the project are prepared by appropriately licensed practitioners.

k. Design Engineer: An individual, partnership, or corporation, or an employee thereof, practicing as a licensed engineer in the State of Maryland, who is preparing contract drawings and documents for a construction project in Brunswick. The term “responsible licensed engineer” shall mean Registered Professional Engineer, as authorized to practice under the laws of the State of Maryland.

l. Developer: A person, firm or governmental agency undertaking or proposing the construction of a structure, a project consisting of interrelated structures or other construction, a subdivision plat and/or Site Development Plan and the public and private improvements involved therein, and who has primary financial responsibility for the proposal.

m. Approval: Specific examination and acceptance by a duly authorized representative of the City of Brunswick.

2.0 DESIGN CRITERIA

2.1 General

For the Engineer's guidance, below are listed major elements constituting the design of a Sewer Utility Design project:

a. Pipe size and alignment

b. Profile, with all elevations

c. Pump station site plan, mechanical, electrical, architectural and electrical elevations, plan views and details

d. Property data (lot dimensions, all sides of affected properties, liber/folio number, owner)

e. Rights-of-way

f. Specifications and notes

g. Cost estimate

2.2 Determination of Design Flows

a. The sizing of major components of the City sewer system such as treatment facilities, are the responsibility of the City and beyond the scope of this manual. The City may require developers to design these facilities as well as finance and construct them. Should this be the case, the City must be consulted for specific design criteria.

b. The design engineer who is responsible for the extensions of sewer mains shall follow the guidelines in this manual for the derivation of design flows. The calculation of sewer flows will usually require extension of the average daily flow for the facility, application of a peaking factor to derive the peak flow, then addition for inflow and infiltration.

c. Generally, the design engineer will be selecting sewer mains of 12-inch diameter and smaller, and often will be required to provide the minimum 8-inch size mains.

2.2.1 Collector Sewers

a. Design Period

A sewage delivery system shall ordinarily be designed to provide for the projected population at ultimate buildout for the contributing drainage area to the facility. Whenever cost-effectiveness permits, the construction may be programmed in stages to accommodate the needs, subject to the approval of the City Commissioners of Brunswick.

b. Existing Development

In developed areas, the basis for flow projection shall be the actual number of single-family homes, apartment units, various types of businesses, etc. present in the drainage area, as determined by field count. An allowance shall be made for undeveloped areas as described below. For each residential dwelling unit, sewage flows of 250 gallons per day for the average daily flow shall be used.

c. Future Development

In small undeveloped areas, the basis for flow projection shall be the maximum number of residential units per acre according to current zoning regulations. This applies to residential or mixed residential/commercial zones. It shall be assumed that each residential unit shall contribute 250 GPD average daily sewage flow. In the case of small undeveloped portions of commercial or industrial zones, design flows shall be based on the land use consistent with the City of Brunswick Master Plan which would provide the most likely maximum sewage flow. In the absence of specific sewer flows, the design engineer shall use 500 Gallons/Acre/Day for commercial and light industrial zoned lands for the average daily flow. Heavy Industrial lands shall be assigned 1,000 Gallons/Acre/Day.

In large undeveloped areas, the average daily flow for a given zoning classification shall be as given above.

d. Average Daily Flow

The average daily flow for collector sewers is based on the population and land use inventories and projections described above. Appendices B and C are compilations of average daily flow generation rates for various types of establishments. The flow from each existing establishment shall be based on Appendix B when the number of persons using a facility can be determined or on Appendix C when only the gross area of the facility can be determined. The average daily flow shall be the sum of the flows projected for the existing or ultimate land use of each lot or parcel in the drainage basin. In the case of largely undeveloped drainage basins, the average daily flow shall be based on criteria in 2.2.1(c).

Average daily flows given in 2.2.1(c) for industrial facilities are for domestic-type flows only. Flows generated by industrial processes must be determined on a case-by-case basis.

e. Peak Flows

Peak domestic flow is the average daily domestic flow peaked in accordance with the curve entitled "Diagram for Converting Average Daily Domestic flow to Peak Flow" in the Appendix.

Peak commercial or industrial flow is the average daily commercial or industrial flow peaked in accordance with a factor determined by evaluation of historical data for the commercial or industrial facilities and the periods in which these flows are generated. If historic peaking data for these facilities is unavailable, the average daily domestic flow, average daily commercial flow, and average daily industrial flow may be combined and then peaked using the curve in the Appendix.

If it can be established that the peak of the industrial waste flow (and other non-domestic flows) does not occur during peak domestic flow, a percentage (based upon engineer's field observation and judgment) of the peak industrial waste flow (and other non-domestic flow) shall be added.

f. Infiltration and Inflow

In areas where a sewer is being designed to replace an existing sewer with existing SHC's, a minimum infiltration rate of 400 gallons/acre of drainage basin per day shall be used. A higher rate of infiltration may be justified if there is evidence of poor soil conditions, high groundwater table, or deteriorated SHC's.

In areas where the sewer will serve future development, the infiltration rate should be determined on a case-by-case basis. Factors affecting this determination include the proposed sewer elevation relative to the normal groundwater elevation and the soil types present. The infiltration rate selected for design of new sewers shall be 100 gpd/in-dia/mile.

New clear water connections such as downspouts, catch basins, cellar drains or sump pump drains to sanitary sewers are strictly prohibited from the date of adoption of this ordinance.

g. Design Hydraulic Flow

The design hydraulic flow shall be the sum of the peak flows determined as described in Section 2.2.1 (e), the infiltration rate determined as described in Section 2.2.1 (f), and any industrial flows.

2.2.2 Interceptor Sewers

a. Design Hydraulic Flow

Determination of design hydraulic flows for interceptor sewers shall be generally as outlined for collector sewers. Peak flows generated by ultimate development allowed by the City of Brunswick Master Plan shall be provided for. Interceptors which will carry the flows from a significant number of older collectors may have infiltration rates far in excess of 400 gallons/acre/day. The design engineer may be required by the City to perform flow monitoring in the existing sewer to determine actual flows and remaining capacity if actual flow data is not available by the City. In all cases, the design hydraulic flows shall be approved by the City of Brunswick prior to proceeding with sewer design.

2.3 Hydraulic Criteria

2.3.1 Collector Sewers

a. Size

The size of the sewer shall be sufficient to carry the previously discussed design hydraulic flow with the hydraulic gradient coincident with or slightly below the crown of the pipe. Size shall be determined by the relationship $Q = av$, where:

Q = quantity of sewage in cfs (design flow)
a = required cross section area of conduit in sq. ft.
v = velocity in feet per second

The minimum size sewer shall be 8-inch inside diameter.

b. Velocity

Velocity shall be determined by the Manning formula:

$$v = \frac{1.486}{n} r^{2/3} s^{1/2}$$

n = coefficient of roughness as indicated in Section 2.4.1.e.5.
s = slope in feet per foot
r = hydraulic radius - area divided by wetted perimeter

Minimum velocities of 2.5 feet per second shall be provided. Minimum velocities shall be determined based upon present average sewage flow.

Where velocities greater than 15 ft/sec are attained, provision shall be made to protect against erosion and displacement by shock. If practical, suitable drop manholes shall be provided to reduce steep slopes so as to limit the velocities in pipes between manholes. When drop manholes are impractical for reduction of velocity, the sewer shall be of ductile iron or other abrasion resistant material as approved by the City of Brunswick.

2.3.2 Interceptor Sewers

a. Size

Interceptor sewers shall be sized to carry the design hydraulic flow when two-thirds full (i.e. the hydraulic grade line will be d/D - 0.67). The minimum size shall be 8 inches inside diameter.

b. Velocity

Velocities in interceptor sewers shall be as presented for collector sewers.

2.4 System Layout Criteria

2.4.1 Collector Sewers

a. Horizontal Layout

1. General

Collector sewers shall be laid on tangents only. All changes of direction and connections to other collector sewers shall be accomplished at manholes. In laying out the sewer, the design engineer shall take into full account such factors as environmental impact, maintenance of traffic, maintenance of existing utility services, constructability, and system maintenance.

2. In New Subdivisions

In new subdivisions, collector sewers shall be located seven feet from the centerline of the street right-of-way, generally on the side of the street toward low ground and on the opposite side of street centerline from the water main. Collector sewers shall be located within the pavement area wherever possible, no less than five feet from the face of the existing or proposed curb. Where it is not

feasible for manholes to be located within the pavements, they shall be located wholly within the grass plot or wholly within the grass plot between the curb and sidewalk or wholly within the sidewalk.

3. In Existing Developments with Curbs

In existing developments with curbs, sewer location shall generally be the same as in new subdivisions. The location of other existing and proposed utilities shall be fully considered.

4. In Existing Developments with Pavement and No Curbs

In existing developments without curbs, collector sewers shall generally be located four feet outside of the edge of pavement, except that the sewer shall not be located under a future curb. The location of other existing and proposed utilities shall be fully considered.

5. In Parks and Public Rights-of-Way

Where location of sewer would require removal of or damage to trees within parks or public rights-of-way, design engineers shall obtain approval of the City of Brunswick for sewer alignment and trees to be removed.

6. Easements

All sewer utility easements shall be 30 feet minimum width. No other utilities will be allowed in the sewer easement without the City of Brunswick's permission.

b. Profile Layout

1. Grades

Grades shall be such as to require the least excavation while satisfying minimum and maximum velocity requirements, clearances, and depth requirements discussed hereinafter. All collector sewers shall be on tangent grades with required breaks in grade accomplished at manholes. Minimum slopes shall be as provided for in the Maryland Department of the Environment "Design Guidelines for Sewage Facilities," latest edition.

Terminal sewer collection lines shall be at a minimum 1% grade.

2. Changing Size

When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method is to match the crown of the sewers or to place the 0.8 depth point of both sewers at the same elevation. Generally, sewers should not decrease in size in the downstream direction.

3. Depth

In developed areas, sewer inverts shall be a minimum of 2.5 feet + h below cellar elevations, where h = length of house lateral connection between the sewer and the point of connection to the existing house sewage system, or stack, multiplied by the required house connection slope. For houses without cellars, sewers shall be a minimum of 2.5 feet + h below first floor elevations. In all cases, sewer depth shall be sufficient to meet criteria established for house connection, depth, grade and clearance.

For unimproved lots, maximum sewer depth as controlled by adjacent lots shall generally not exceed 12 feet. Where lots can be expected to be filled to the level of the established grade, depth as regulated by adjacent house connections shall normally not exceed eight feet. Greater depth may be required to clear future storm drains. In all cases, depth shall be sufficient to meet criteria established for house connection depth, grade and clearance.

Sewers at stream crossings shall be constructed with a minimum of three feet of cover between pipe and stream invert. At all stream crossings the design engineer shall consider such items as flotation, stream meandering and scouring and infiltration and shall include such protective measures in the design as encasement, riprap, special pipe, and joints as may be deemed necessary by the City.

4. Gravity Service Not to be Provided

Sewer project plans shall clearly label any improved lots for which gravity service is not to be provided. Any recommendation for not providing gravity service is to be documented, with the reasons therefore, by the A/E to the City for decision. For lots where it is determined that gravity service is not available and the City approves the use of grinder pumps, a note shall be placed on the drawings as follows: “A grinder pump is required for sewer service to this lot.”

5. Test Borings

Soils investigations (test borings and/or test pits) may be required by the City as a pre-requisite and approval of the plans.

c. Clearances of Other Utilities

1. Interactive Considerations

In general, existing utilities have prior right to maintain their location. The existence and location of such utilities must be considered when designing new sewers. Clearance shall be measured between outside of pipes. Design engineers shall investigate clearance between sewer and other utilities, both existing and future.

(a) Parallel Installation

A horizontal distance of at least 10 feet shall separate water mains and sewers. The distance shall be measured edge to edge. In cases where a 10-foot separation is not practical, deviation may be allowed on a case-by-case basis subject to City and State approval if supported by data from the design engineer. Such deviation may allow closer installation, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

(b) Crossings

Where water mains and sanitary sewers, building drains or storm drains must cross, there shall be a vertical separation of 18 inches between the bottom of the water main and the top of the sanitary sewer, building or storm drain. This vertical separation must be maintained horizontally for a distance of 10 feet. The 10-foot distance is to be measured as a perpendicular distance from the sewer, building or storm drain to the water line.

(c) Exceptions

When it is impossible to obtain the proper horizontal or vertical separation as stipulated above, both the water and

sewer lines shall be constructed of ductile iron with mechanical joints. Other types of pipe and joints with equal or greater integrity may be used at the discretion of the City. Where a water main must cross under a sewer, additional protection of the water main shall be provided. The City shall be consulted to discuss the use of double casing or concrete encasement of the sewer and/or water main. (See details in Appendix.)

2. Separation of Utilities and Sewer Manholes

No utilities shall pass through any part of a sewer manhole.

3. Clearances at Other Utilities

Sewers shall have a minimum of 12 inches clearance from drains, gas mains, and other unspecified utilities. If 12 inches cannot be maintained at crossings, provide encasement of sewer for the width of 10 feet on each side of the crossing.

d. Appurtenances

1. Manholes

Manhole details are shown in the City's Standard Details. The designer shall use these standards as required to meet the design situation and shall designate the type of each manhole on the contract drawings. Maximum spacing for manholes shall be 400 feet. Line manholes shall generally be used at all changes of pipe size, grade, alignment, or connections of two or more sewers. A minimum drop of 0.10' shall be used at line manholes. Generally, a drop pipe should be provided where the difference between the crown of the effluent sewer and the invert of the influent sewer exceeds 2 feet, subject to the limitations of standard fittings. Concrete encasement should be provided to support the drop pipe.

The minimum diameter of manholes shall be 4.0 feet. Larger diameters are preferable. The size of manhole entrance shall be 2.0 feet or larger in diameter. The thickness of manhole walls shall not be less than 8 inches for the upper 12 feet of depth and shall increase 4 inches for each additional 12 feet of depth. The flow channel through manholes shall be made to slope and conform in shape to the sewers.

e. Structural Considerations

1. Soil Conditions - Foundations

   Where extremely poor soil conditions, such as running sand, material with high organic content, etc. are anticipated, design engineers shall secure soil samples and discuss the analysis of the samples with the City. In all cases, a proper foundation shall be provided for pipes.

2. Grades - Anchors

   Sewers designed on slope of 20 percent or greater shall have anchorages as follows (consult the City for details):

20% - 34%	36' center to center (max.)
35% - 50%	24' center to center (max.)
50% +	16' center to center (max.)

3. Underdrains

   Where there is evidence of spring heads or a high groundwater table in the area of the proposed sewer, underdrain shall be provided. Underdrains shall be extra strength concrete sewer pipe (CSPX), or pipes of equal strength, and need to be shown on the drawings.

4. Depth and Loading

   Minimum and maximum permissible depths and loadings for pipes of the various types and classes shall be in accordance with manufacturer's recommendations and bedding requirements. Manufacturer's data shall be submitted as part of the Engineering report. Ductile iron pipe shall be used where depth is less than 4 feet or greater than 20 feet. PVC pipe, SDR 35 may be used for depths of 4 feet to 10 feet. PVC pipe SDR 26 may be used for depths of 10 feet - 20 feet.

5. Pipeline Materials

   The materials allowed for sewer construction, together with their Mannings 'n' are listed below. The choice of materials is at the engineer's discretion, subject to the City's approval, provided allowable maximum velocities and structural loading criteria are met. Fittings that are necessary for wye branches, etc., shall be approved by the City. Only one type and description of pipe shall be used between two manholes.

Pipe Type (abbreviation)	'n' Coefficient	Range of Diameters
Ductile Iron (DIP)	0.013	6" & larger
Reinforced Concrete (RCP)	0.013	12" & larger
Concrete Sewer Pipe (Extra Strength) (CSPX)	0.013	6" & larger
Polyvinyl Chloride (PVC)	0.010	6" & larger
Reinforced Concrete Cylinder (RCCP)	0.013	16" & larger

Design engineers shall consider the effect of industrial waste on sewer pipe. Several industrial wastes, such as sulfuric acid, are known to cause deterioration of concrete pipe. Wherever harmful wastes cannot be prohibited from sewers or diluted prior to entry, the use of liner plates or other pipe protection shall be required for concrete pipe. In addition to consideration of industrial wastes, the design engineer shall also consider other local conditions, such as septicity, exceptionally heavy loadings and abrasion due to high flow velocities, in selecting pipe materials.

Use Ductile Iron Pipe (DIP) under the following conditions:
- Where sewer depths are 4 feet or less.
- Where sewer depths exceed 20 feet.
- In interceptor sewer applications where maintenance is perceived to be a problem
- Creek or stream crossing (alternative to DIP is concrete encasement of PVC 10 feet either side of stream bank).
- Off road areas where maintenance is not achievable or where individual homeowners may be severely affected by repair efforts

f. Venting

The design engineer shall indicate method of proposed ventilation of gravity sewers.

g. Testing

Sewer mains shall be tested in accordance with the City's specifications, using air testing procedures. All manholes are to be vacuum tested.

h. Jacking and Tunneling

Where mains are being designed to cross railroads, state highways or other roads on which service cannot be interrupted, the sewer main shall be installed in a sleeve, tunneled or jacked under the road. The sleeve size

and material and the method of tunneling or jacking shall be approved by the owner of the road or the railroad being crossed.

The sleeve diameter shall be sufficient to permit the proper positioning of the sewer main within the sleeve. The annular void between the main the sleeve shall be completely filled with grout, sand or as shown in the Standard Details.

2.4.2 Interceptor Sewers

a. Horizontal Layout

Interceptor sewers generally follow streams or the valley of a drainage area. They shall be located so as to best serve the drainage area. Special caution is required to insure the proper location of manholes for future connection of collecting sewers and ease of maintenance by the City.

Sewers shall be laid with straight horizontal alignment between manholes. Where the sewer is planned in a City road right-of-way or a park, layout shall be as described for collector sewers.

b. Profile Layout

Grade requirements shall generally be as described for collector sewers. The depth of interceptor sewers is not directly controlled by lot and house elevations. The depth of interceptor sewers shall be sufficient to allow connection of all existing and foreseeable future collector sewers within the drainage basin served. In general, sewer elevation should be three feet lower than the stream bed and have six feet of cover where possible.

Where interceptor sewers cross streams, the requirements of Section 2.4.1.e.5 shall be met, except that concrete encasement shall be required in all cases and will extend 20 feet each way from the stream bank.

c. Clearances at Other Utilities

The requirements for horizontal and vertical clearances between interceptor sewers and other utilities shall be the same as those for collector sewers.

d. Appurtenances

Manhole requirements for interceptor sewers shall be the same as those for collector sewers, with the following modifications. Manholes will be

required where collector sewers join the interceptor. Precast concrete manholes constructed shall meet the standard ASTM C478 criteria.

e. Structural Considerations

Structural considerations shall be the same as for collector sewers.

2.5 Grinder Pumps/Pressure Sewer Systems

2.5.1 Purpose

The purpose of this section is to provide a Policy and Procedural Guide for Alternate Wastewater Systems. The following is for Grinder Pump/Pressure Sewer Systems to serve existing or proposed development.

2.5.2 Policy

a. Determination of Use

Grinder Pumps/Pressure Sewer Systems will not be considered as a method of providing sewer service that could otherwise be furnished by conventional gravity system (including pumping stations) at a reasonable cost. A final determination on the use of grinder pumps will be made by the City of Brunswick. An economic analysis, based on a total present worth, must be submitted by the developer or design engineer for use by the City in making the final decision.

b. Temporary Use

Grinder Pumps/Pressure Sewer Systems are not normally to be used on an interim or temporary basis in anticipation of conventional facilities installed in the future.

c. Ownership and Maintenance

The property owner will own and maintain all grinder pumps, regardless if installed by the City, Developer, or by property owner. The property owner will be responsible for electrical costs to operate the pumping units.

d. The manufacturer of grinder pumps shall be approved by the City. Low pressure sewer mains shall be sized according to the design manual offered by the grinder pump manufacturer. The City shall be consulted on specific design and construction standards for the grinder pump and low pressure sewer mains, if approved for use by the City of Brunswick.

2.6 Sewer House Connections

2.6.1 Location

The City-owned portion of house connections shall be built to the property line for all lots within proposed developments. All adjacent improved lots which are not a part of the proposed development but which may be served by the sewer line shall be shown on the contract drawings. Connections for these lots shall be shown, where and as directed by the City. Where sewers are at sufficient depth to require drop house connections, design engineers shall discuss house connection location with the City. No twin sewer house connections shall be allowed. The City will not permit extension of sewer connection beyond the corporate boundaries with the possible exception to serve public facilities, such as parks, on a case-by-case basis.

2.6.2 Size

Connections to large buildings such as apartments or commercial/industrial properties shall be designed and sized in accordance with the criteria previously presented for collector sewers. The minimum connection size for home and smaller buildings shall be four inches diameter.

2.6.3 Materials

House and building connections shall comply with ASTM 3034, SDR 35 PVC; ASTM F789, T-1 PVC; or AWWA C151 DIP.

2.6.4 Appurtenances

Cleanouts shall be provided on all building connections at the property line. Cleanouts shall be as shown in the Standard Details. All cleanouts must be installed vertically to be accepted by the City. This cleanout is to be used on all systems regardless of the air test requirements. No solvent weld joints will be allowed.

2.6.5 Grades

House and building connections shall be two percent minimum grade, unless otherwise approved by the City. The maximum grade shall be five percent. A one percent minimum grade may be allowed by the City with adequate justification from the Developer and approved by the City. Minimum cover at property line shall be four feet. Where storm drains have not been designed or have not been installed, house connections shall have a minimum cover within the street right-of-way of 6.5 feet.

2.6.6 Clearance

a. Crossing Water Main

Clearance shall be measured between outside of pipes. Sewer house and building connections crossing water mains (existing or future) shall be a minimum of 12 inches clear below water mains. Sewer house and building connections crossing above water mains shall be encased in concrete (see detail in Appendix) 10 feet each side of water main or constructed of ductile iron pipe (push-on or mechanical joints).

b. Parallel to Water House Service

Sewer house and building connections shall ordinarily be not less than 10 feet horizontally from water house service and a minimum of one foot clear below water house services. If City approves placing sewer house or building connections above water house service, such connection shall be ductile iron pipe (push-on joints or mechanical joints).

c. Crossing Storm Drains and Other Utilities

Sewer house and building connections crossing storm drains and other utilities (existing or future) shall have a minimum clearance of six inches from these utilities.

2.6.7 Structural Considerations

Minimum and maximum permissible depths shall be in accordance with those of collector sewers.

Where poor soil has required the use of ductile iron pipe collector sewers or ductile iron pipe (DIP), house and building connections of the same material shall be used.

2.7 Repaving of Roads

2.7.1 General

a. All City construction contract specifications shall include a “patch-pave” requirement as follows:

Properly compacted borrow aggregate backfill shall be placed and compacted from 3 inches below the pipe to the bituminous pavement subgrade. The pavement replacement shall consist of a base course of asphaltic concrete of at least a thickness equivalent to the original

pavement section, the original wearing course cut back two feet on all edges of the excavation and a new asphaltic concrete wearing course of at least a thickness equivalent to the original wearing course. Other road pavement sections will receive similar treatment. The base course shall be a minimum of 4 inches, and the wearing course shall be a minimum of 2 inches.

b. Patch-paving as outlined above is to be accomplished whether the roadway is to be re-paved or not.

c. House connection installations will require the same specifications for patch-paving.

d. All paving/re-paving work will be accomplished in accordance with the City Road Specifications or Design Manual. A 'road cut' permit must be obtained from the City when excavating within an existing City-maintained roadway.

e. Pavement patch on State or County roads shall be in accordance with requirements of the applicable agency.

2.7.2 Timing of Patch-paving and/or Re-paving

a. Specifications will provide that patch-paving shall be accomplished immediately after backfilling and achieving specified compaction for connection and small extension contracts and at no greater than seven (7) calendar day intervals for larger projects. Temporary "cold patch" shall be required for patches not immediately patch-paved. The City must be consulted if immediate patch-paving cannot be accomplished. Cold patching must be maintained by the developer to the City's satisfaction. The placement of steel plates over trenching may be approved by the City on a case-by-case basis.

b. Re-paving shall be specified to be accomplished in one continuous effort to best assure economy and consistency of quality work.

2.7.3 Traffic Control

All water utility construction projects shall have an approved traffic control plan, using requirements of the Manual on Uniform Traffic Control Devices.

3.0 SEWAGE PUMPING STATIONS

3.1 General

These design standards are intended to facilitate engineering of sewage pumping stations to meet the service needs of users and the operational responsibilities of the City. The sewage pumping station design standards include criteria and design guidelines. This section includes the criteria and guidelines for designing sewage pumping stations within the limits of applicability for these design standards.

The design standards generally apply to sewage pumping stations up to 3.0 MGD capacity. Not included within the group of sewage pumping stations covered by this section are several special applications: individual user pumping installation, lift stations, and sewage pumping stations with capacity in excess of 3.0 MGD.

The design engineer shall check with the City to determine the applicability of these design standards to planned sewage pumping stations. It is the responsibility of the design engineer for blending all applicable criteria and guidelines for sewage pumping stations incorporated into the City of Brunswick Sewage System.

3.2 Design

3.2.1 Design Criteria

Sewage pumping stations must satisfy the criteria relating to regulations of agencies having jurisdiction, design flow rate, hydraulic conditions and site characteristics.

a. Applicable Regulations

Sewage pumping stations shall conform to the Design Guidelines for Sewerage Facilities, 1978 edition or latest as published by the Department of the Environment, State of Maryland. City of Brunswick Office of Planning and Zoning land use regulations shall be considered in the selection and development of sewage pumping station sites. Buildings shall comply with BOCA requirements and permitting requirements of the City of Brunswick. Other regulations governing facilities and construction shall be adhered to. These will include the Occupational Safety and Health Administration, National Electric Code, Frederick County Plumbing Code and others.

b. Flow

The design flow for sewage pumping stations shall consider existing and project peak flow rates and sewage composition.

(1) Planning Period

Sewage pumping station discharge flow rates shall, at a minimum, accommodate a 20-year planning horizon. In circumstances where the status of a planning pumping station is interim, the planning period for establishing flow rate may be shorter. For all but interim pumping stations, consideration shall be given to future upgrading flexibility necessary to accommodate flows beyond the normal 20-year planning horizon. This is especially important for larger (more than 200 GPM) sewage pumping stations.

(2) Existing and Projected Flow Rates

Sewage pumping stations shall be designed to pump the flow for existing and future users. In developed areas population shall be determined by house count and non-domestic user inventory, with allowances made for remaining undeveloped tributary areas. Population densities and per capita flows shall be as established by Facility Plans or, in their absence, in agreement with the Water and Sewer Master Plan or instruction of the City.

(3) Composition

Sewage composition can vary widely, depending upon the proportion of design flow generated by non-domestic users. Non-domestic user sewage composition shall be investigated. Adequate consideration and necessary provisions shall be taken to ensure that sewage pumping station equipment and materials are suitable for the anticipated composition of sewage. Consultation with the City is required in the event that sewage composition affects standard material and equipment requirements.

c. Hydraulics

A complete analysis of each sewage pumping station is required. An investigation and analysis of the sewage pumping station and force main system to consider features of configuration and operation shall be conducted. Sewage pumping stations shall be designed to operate at the appropriate discharge head and flow rate.

(1) Pump/System Curve

System curve characteristics shall be determined by the Williams-Hazen formula for piping headlosses. The pump/system curve shall be shown on the drawings.

(2) Water Hammer

The potential impact of water hammer shall be evaluated. If the combined effects of static head and water hammer do not exceed the weakest piping system component working pressure, no special provisions need to be included to control water hammer. Where the maximum water hammer pressure exceeds the weakest piping system component working pressure, strengthen those elements affected, or select an appropriate device to control water hammer. The decision to strengthen piping system components instead of utilizing a water hammer control device shall be based upon life cycle cost economic comparison.

d. Siting

Sewage pumping station site selection is dependent on a number of factors. Topography, access, availability of power supply, floodplain, land use, esthetic concern, overflow potential and impact to the environment shall collectively be considered in the process of site selection.

(1) Topography

Sewers tributary to sewage pumping stations commonly dominate site selection. Adjacent drainage areas potentially served by the sewage pumping station must also be considered. Sewage pumping station site selection shall also be compatible with suitable access and soil capability with respect to landgrading in conjunction with site development.

(2) Access

All sewage pumping stations shall be sited to permit access by all weather surface roads. Access road and parking or working areas within the pump station must be paved with bituminous or concrete pavement. The depth of pavement shall be dictated by the City of Brunswick.

(3) Floodplain

Sewage pumping stations shall be sited to remain operational and permit access during a 100-year return frequency flood.

(4) Land Use

Sewage pumping station sites should be selected to occupy vacant land. In new subdivisions the sewage pumping station site shall occupy an area at least equivalent in size to the minimum

allowable lot size. In existing subdivisions site size shall meet the minimum allowable lot size if possible. Pump station sites wherever possible must conform to land use regulations such as building restriction lines. Special exceptions and variances may be required.

(5) Esthetics

Natural screening and remoteness of site should be provided by site selection wherever possible. Where pump stations are sited in proximity to developed areas, predominate wind direction for potential odor dispersion and building aspect for generator exhaust and ventilation fan noises shall be considered.

(6) Overflow

Sewage overflow at sewage pumping stations is not permitted. Sewage pumping station sites shall be selected to permit site development which will preclude on-site overflows.

3.2.2 Guidelines

To the extent practical, sewage pumping station designs shall conform to the guidelines given. The guidelines shall be applied to design situations in a careful and thoughtful fashion.

a. Selection of Sewage Pumping Station Type

The type of sewage pumping station required by the City will be governed by station capacity in terms of flow rate and horsepower. Sewage pumping stations will be custom built-in-place wet well/dry well type, engineered package wet well/dry well type, engineered package submersible type, or engineered package wet well mounted suction lift type subject to the limitations set forth.

(1) Custom Built-In-Place Wet Well/Dry Well Sewage Pumping Station

This type of sewage pumping station will be designed for installation with design flows above 1.5 MGD. Custom-built in-place stations shall be engineered to meet the requirements of these guidelines.

(2) Package Sewage Pumping Station

This type of sewage pumping station will be utilized for design flows of 1.5 MGD and less. Depending upon flow rate and motor horsepower, the packaged pump stations will be wet well/dry well configuration, submersible configuration, or wet well mounted suction lift station. Packaged sewage pumping stations shall be engineered to meet the requirements of these guidelines.

(a) Submersible

Submersible sewage pumps with guide rail and pump discharge elbow assemblies installed in the wet well shall be used for small sewage pumping stations. Submersible type sewage pumping stations shall be used at locations where design flow does not exceed 200 GPM and motor horsepower is 10 or less. If either motor horsepower or design flow limitations for submersible type sewage pumping stations are exceeded, other types shall be used.

(b) Dry Well/Wet Well

Dry Well/wet well sewage pumping stations may be used where flows are in excess of 200 GPM or where a submersible station would require a motor greater than 10 horsepower.

(c) Wet Well Mounted Suction Lift Station

This type may be used where flows are in excess of 200 GPM or where a submersible station would require a motor greater than 10 horsepower. Suction lift stations generally are only to be used where the depth of wet well is less than 15 feet.

(3) Other Configurations

In special circumstances due to extraordinary sewage composition, rehabilitation of an existing installation or other reasons, the City shall be consulted to determine the acceptability of other configurations before sewage pumping station design begins.

b. Site Improvements

Sewage pump stations must be developed with the necessary improvements to ensure adequate and reasonable access, security, drainage and maintainability.

(1) Access Road

All sewage pumping stations must provide complete vehicular access.

(a) Duty and Section

Access roads should be designed to accommodate all types of vehicles at low speeds from passenger automobiles up to large tanker trucks. An all weather surface with cross section design adequate to support the vehicular loads anticipated should be designed for local soil conditions. Access roads shall be a minimum 12 foot wide single lane with 2 percent cross slope to provide surface drainage. Two foot wide shoulders on each side of the road surface shall be included with a cross slope of 6 percent. Swales, ditches and culverts as necessary shall be provided to ensure adequate storm drainage for a 10-year return frequency rainfall event. Grading and slope stabilization in conjunction with access road design shall be compatible with local soil conditions. In no case shall the depth of bituminous pavement or concrete be less than 6 inches.

(b) Geometry

Horizontal access road geometry shall permit vehicular movement such that vehicle tires can remain on road and shoulders at all curves. Turning flares shall be provided at the intersection with traveled roads. Vertical access road geometry shall provide smooth grade transitions and adequate site angles at intersections with traveled roads. Access road grades should be limited to 8 percent, but in no case may exceed 12 percent. Access roads shall satisfy all horizontal and vertical geometry requirements for vehicles in size up to large unit trucks.

(c) Security

Access roads longer than 75 feet in length shall include a padlocked entrance chain between pipe bollards across the access road. The chain and pipe bollards shall be set back a minimum of 5 feet from the right-of-way line. Consideration may be given to access road entrance chain and pipe bollards for access roads less than 75 feet in length.

(2) Sewage Pumping Stations

All sewage pumping station sites shall be improved with paved surfaces, security fences, site lighting and screening. Certain locations and attendant conditions may require other improvements which may consist of storm drainage systems or more extensive security provisions.

(a) Perimeter Fence

All sewage pumping stations must have a 6 foot high chain link fence surrounding the parking area, building, wet well, dry well and vaults. In areas particularly subject to vandalism, higher fences and electronic security systems should be considered on a case-by-case basis. Full width fence gates, up to fourteen feet wide, with padlocked astrigal shall be located to suit entry and exit of the pump station site. All exposed fencing materials shall be black vinyl coated.

(b) Paving and Other Surfaces

Sufficient bituminous paved surfaces, within the sewage pumping station perimeter fence, shall be provided to enable maneuvering and turning of vehicles in size up to unit trucks. The paving section composition shall consist of band SN surface course, an underlying band BF and a CR-6 crushed stone base course, all of a composite thickness necessary to support all anticipated wheel loads in consideration of local soil conditions. The remaining surfaces inside the perimeter fence not occupied by structures shall be covered with a compacted course of washed SRC-2A stone of thickness equal to bituminous concrete site paving and underlain by a CR-6 crushed stone base course of thickness equivalent to the paved surface base course.

(c) Grading

Sewage pumping station grades for paved areas shall prevent local ponding, provide positive drainage away from structures and generally be limited to no greater than 4 percent slopes. Stone surfaces around paved areas shall provide proper site drainage at slopes 10 percent or less. Landgrading outside of the sewage pump station perimeter

fence shall not exceed 3 to 1 slopes, and 4 to 1 slope maximums are desirable. Lesser slopes wherever possible are preferred. Site grading design shall be compatible with slope stability for soils encountered. Slope stabilization shall be appropriate for the degree of slope and soil conditions.

(d) Landscaping

All sewage station sites shall be screened as appropriate for surrounding development.

Landscaping materials should be aesthetically pleasing and require minimal maintenance.

(e) Lighting

Exterior lights shall be wall mounted on the pump station building, high pressure sodium type controlled by a photocell.

(3) Structures

All structures shall be protected from 100-year return frequency floods. Structure foundation design shall be based upon geotechnical evaluation of underlying bearing stratum. The design engineer shall include the geotechnical report and boring report in the project specifications.

(a) Building

Sewage pumping station electrical, control and standby power systems are to be housed in an at-grade brick and block building with wood roof trusses and shingles. Prefabricated concrete buildings may be used only if approved by the City. The building shall be sized to afford reasonable access to and removal of all components housed within. Details of construction shall follow the architectural, structural, mechanical and electrical standard design. All buildings shall be designed to comply with BOCA Building Code and comply with the Brunswick Floodplain Ordinance.

The control room shall be heated with an electric unit heater to automatically maintain 68º F during the winter.

The control room shall be ventilated to eliminate heat buildup during the summer. An exhaust fan shall be provided and controlled by a thermostat.

(b) Pumping Station

Sewage pumping equipment will be located in a below grade concrete structure of the type indicated for the capacity planned. The pumping station concrete structure(s) shall extend at least 6 inches above finished grade.

(c) Vaults

Precast concrete vaults for emergency station bypass pumping connections and valves shall be provided for package sewage pumping stations. Valve vaults for submersible sewage pumping stations shall be segmented and contain emergency connection couplings and valves in one compartment and all pump discharge check valves, isolation valves, gauges and flushing connection control valve in a separate compartment. Submersible sewage pumping station vaults shall extend 6 inches above grade and shall have hatches and ladders with spring-loaded extension poles to access valves and emergency connection couplings. Vault dewatering when required will be accomplished with portable pumps. Vaults normally will be surrounded with bituminous concrete paving.

c. Sewage Pumping Station

Sewage pumping station structures, equipment systems, piping, controls and accessory systems must be engineered according to these guidelines to form a cohesive design integrating the intended service and operational characteristics stipulated. To fulfill the intent of these guidelines, the designer must exercise judgment to use the special knowledge relating to project site characteristics and conditions of service (head, flow, force main, etc.) particular to the sewage pumping station design under development.

(1) Wet Well

Wet wells shall be as hazard-free as possible and of corrosion-resistant materials.

(a) Structure

Sewage pumping station wet wells shall be constructed of reinforced concrete. Package sewage pump station wet wells shall have cast-in-place base slabs and top slabs with precast riser sections. Custom built-in-place sewage pump station wet wells shall be compartmented and constructed entirely of cast-in-place reinforced concrete. The structural design of cast-in-place concrete is the responsibility of the design engineer. Wet wells shall have an interior epoxy paint finish and exterior elastomeric membrane waterproofing in accordance with Technical specifications. Wet wells shall be adequately designed to prevent floatation. Wet well size and depth shall be as required to accommodate the influent sewer, pump suction submergence as recommended by Hydraulic Institute Standards or in the case of submersible pumps complete pump submergence. The required working volume and preferred intervals between sewer and control elevations shall be determined as follows:

(i) Working Volume (in Gal.) = $\frac{TQ}{4}$

Where T = minimum time between motor starts or 7 minutes, whichever is greater

Q = discharge rate of one pump in operation in GPM

Working Volume = lead pump on - lead pump off

(ii) Minimum inside width - 6 feet

(iii) Minimum elevation difference between influent sewer invert and high water alarm - 6 inches

(iv) Minimum elevation difference between control elevations - 6 inches

(b) Access

Package pump station wet well access shall be through a top slab opening with aluminum hatch cover and frame. The top slab access hatch shall be 36 by 30 inches minimum size and as large as necessary to allow removal of

equipment from the wet well. An aluminum ladder with extendible springloaded aluminum safety poles at the top shall be provided to permit safe entry. Structures 20 feet in height or more shall be equipped with removable intermediate landings as required to obtain less than 20 foot intervals. The ladder landing on the wet well floor shall be flat. Custom built-in-place wet well personnel access shall be stairs, minimum of 36 inches wide. Provisions should be made for wet well access openings large enough for equipment removal.

(c) Wet Well Work Platform

Package pump station wet wells shall have an intermediate platform completely covering the wet well. The work platform shall be constructed of aluminum grating sections and grating supports of structural aluminum shapes fastened to the wall. Custom built-in-place pump station wet wells shall have an aluminum perimeter platform with handrail over the wet well and screening channel. Seven feet minimum of headroom over work platforms is desirable. Care shall be taken to locate removable grating sections consistent with equipment placement and removal requirements. All fixed grating shall be bolted down as detailed. All fasteners to be stainless steel.

(d) Debris Removal

All sewage pumping stations will have bar racks for debris removal. Package sewage pumping stations will have manually cleaned static bar racks attached to the wet well wall and work platform. Static bar racks shall be of welded aluminum and stainless steel construction with a welded aluminum debris basket to accept bar rack strippings. The debris basket shall be removable and should be easily hoisted through the open access hatch above. Custom built-in-place sewage pump stations shall have a special debris screening channel and bypass channel upstream of the segmented wet well. Aluminum stop gate guides shall be cast into the channel walls for insertion of flow isolating aluminum stop gates. The debris screening channel shall be fitted with a mechanical bar rack of the front cleaning design with no moving parts below the sewage in the channel. Strippings from the mechanical bar rack shall be shredded or ground and returned to the channel without

need for further handling at the sewage pumping station. Mechanical bar rack sizing shall be based upon maximum through bar velocity of 3 feet per second. Maximum clear opening between bars shall be 1-1/4 inches for all bar racks. Bar rack headloss shall not cause any reduction in influent sewer flow velocity.

(e) Invert Slope

Wet wells shall have sloping sides to form a hopper at the bottom of the wet well. Package sewage pumping stations shall have grout fill slopes of 1 horizontal to 1.75 vertical. Custom built-in-place sewage pumping station wet wells shall have side slopes of 1 horizontal to 1 vertical if possible. The flat portion of the wet well floor shall be sufficient in area to accommodate equipment mounting, ladder landings and recommended pump suction hydraulic pump suction hydraulic conditions as outlined by Hydraulic Institute standards.

(f) Level Control

Wet well liquid levels are controlled by a solid state submersible level transducer with D152 controller from Consolidated Electric with back up float switches. Other types of controllers may be required, depending on the complexity and control logic the City requires. These systems within the wet well shall be located to minimize the turbulent influence of flow into the wet well on the control of liquid level. Float staffs shall be readily removable from the wet well work platform.

(g) Odor Control

Odor control method selection will be offered by the design engineer for approval by the City. The City reserves the right to require a different method if deemed appropriate. It should be assumed that a pump station with a greater than two-hour force main detention time will produce both H_2S and NMOC levels greater than 5 ppm and require odor control.

(h) Lighting

Wet wells shall be provided with wall mounted explosion proof incandescent light fixtures with guard and globe. One fixture shall be installed above the grating and one fixture below the grating. A waterproof switch shall be installed to operate the lights.

(i) Ventilation

Wet wells shall be provided with a separate ventilating system and shall be sized to provide a minimum of 30 complete air changes per hour. In addition to manual control, time clock operation of fans shall be provided to allow a minimum of 2 complete air changes per hour. Ventilation shall be accomplished by the introduction of fresh air into the wet well under positive pressure. If the fan is installed outdoors, the fan housing shall be weatherproof construction. The entrance hatch to the wet well shall be provided with a switch to energize the fan whenever the hatch is open.

(j) Dewatering

Package sewage pumping station wet well dewatering shall be accomplished by means of a portable submersible pump. Suitable grating openings and wet well floor space shall be provided for this purpose. Custom built-in-place sewage pumping station wet wells shall have individual valued drains to a common station drain sump. The drain sump shall be duplex solids handling pumps with valved discharge piping to at least two of the wet well compartments.

(2) Dry Wells

Below grade dry wells shall be designed to provide suitable environments for operating and maintaining pumping equipment and piping systems. Configuration of dry well components shall promote safe access and adequate space for equipment and valve maintenance. Hazards must be avoided.

(a) Structure

Sewage pumping station dry wells shall be constructed of reinforced concrete. Package sewage pump station dry

wells shall have segmented precast concrete base, riser, access tube and top slab sections as necessary on a cast-in-place structural concrete base slab foundation. Custom built-in-place sewage pump station dry wells shall be constructed integral with the wet well and above grade building structures. The structural design of all cast-in-place concrete is the responsibility of the design engineer. Dry well exteriors shall be waterproofed with elastomeric membrance as specified in the Technical Specifications. Dry well interiors shall have a smooth, easy to clean special coating finish as specified in the Technical Specifications. Dry well depth and size shall be adequate to provide proper wet well suction and spaces for maintenance and removal of all equipment.

(b) Access

Package pump station dry well access shall be through a top slab opening with aluminum hatch cover and frame. The top slab access hatch and precast access tube riser shall be of sufficient size to permit the removal of an assembled sewage pump or any other station component, if larger. Minimum hatch size shall be 36 inches by 30 inches. An aluminum ladder with extendible spring loaded safety poles at the top shall be provided to permit safe precast concrete dry well entry. Structures 20 feet or more in height shall be equipped with removable intermediate landings as required to obtain less than 20 foot intervals. The ladder landing area shall be sufficiently clear to permit easy ladder use and equipment removal. Custom built-in-place dry well personnel access shall be stairs, minimum of 36 inches wide. Additional grating, plate or concrete covered access openings shall be provided directly above each pump.

(c) Lighting

Precast concrete dry wells shall have wall mounted vapor-proof incandescent lights. Cast-in-place concrete dry wells shall have lighting systems specifically designed to provide illumination best suited for the dry well layout which may include suspended, wall, or ceiling mounted; incandescent, fluorescent, or other types of fixtures. Dry well lighting shall be at levels adequate for routine service inspections and maintenance activities. Portable supplemental lighting

will be utilized for unusual or non-routine maintenance activities.

(d) Ventilation

Dry wells shall be provided with a separate ventilating system and shall be sized to provide 10 air changes per hour. In addition to manual control, time clock operation of the ventilating fans shall be provided. Ventilation shall be accomplished by the introduction of fresh air into the dry well under positive pressure. Precast dry well ventilating fans shall be continuously energized whenever the access hatch is open.

(e) Heating

Thermostatically controlled electric unit heaters shall be provided to maintain a minimum of 55 degrees.

(f) Humidity Control

Precast dry wells shall have small wall mounted dehumidifier units piped to drain in the dry well sump. Cast-in-place concrete concrete dry well dehumidifiers shall be considered on a case-by-case basis.

(g) Sump Pump

Precast dry wells shall have a simplex sump pump with minimum discharge capability as specified in the Technical Specifications. Cast-in-place concrete dry wells shall have duplex submersible sump pumps located in a common station drain sump. Duplex sump pumps shall each have capacity to handle anticipated maximum station drain system flow. Sump pumps shall discharge into the wet well. All dry wells shall be provided with a float switch emergency alarm system to protect the dry well from flooding in the event of sump pump failure. Each sump pump shall have dual check valves installed on the discharge piping to protect the dry well from siphoning from the wet well.

(3) Pumping and Piping System

All sewage pumping stations shall have multiple pumping units. Sewage pumping stations shall be capable of delivering the design flow rate with the largest pumping unit of service. Sewage pumping station design shall permit individual pump maintenance while maintaining the station in operation. Suction and discharge piping must be supported rigidly at or near the pump connections.

(a) Piping

The minimum size for sewage piping (except surge relief valve discharge piping) shall be 4 inch. Pump suction piping velocity should be within the range of 2-1/2 to 5 feet per second. Pump discharge piping shall be sized to provide velocities in the range of 2-1/2 to 10 feet per second. Pump suctions should have free and smooth unobstructed bellmouth openings in the wet well. Individual pump suctions are required for each pump. Flooded pump suction is desired under all normal conditions of operation. Pump suction piping design and installation shall not permit the accumulation of air in the suction piping or induce excessive turbulence in the pump suction area. Long radius suction piping bends to be used whenever possible. Packaged sewage pumping stations shall have adequate piping and fittings to permit station bypass pumping with portable above grade pumps. All sewage pumps shall be provided with casing drains with ball valve shut-offs installed either on the pump suction elbow or on the suction line between the pump and suction isolation valve. Take-off nipples shall be schedule 80 stainless steel. Pipe nipples must not be installed in a tapped hole in piping. Use either a welded-on thread-o-let connection or service saddle.

(b) Valves

Each sewage pump shall have isolation valves to permit the removal or maintenance of the pumps without affecting the operation of remaining pumps. Isolation valves 10 inches and smaller shall be non-lubricated plug valves. 4 to 6 inch plug valves shall be quarter turn to open. Larger plug valves shall have geared operators with handwheels. Isolation valves larger than 10 inches shall be solid wedge, non-rising stem type gate valves with handwheel operators. Plug valves shall be positioned so that when closed, the valve body is isolated from the actively flowing portion of

the piping system. Each pump shall have a swing check valve to prevent backflow through in operative pumps. In accordance with the criteria for water hammer control, check valves shall be of the type and strength required to eliminate water hammer damage. Plug valves shall be 100% port opening.

(c) Bypass Arrangement

As mentioned in Paragraph (a) above, sewage pumping stations shall have additional pipe, valves, fittings and couplings as necessary to permit bypassing of the station pumping units from a vault separate from the pumping station. This vault should be provided with a gravity drain discharging into the wet well. A valve should be provided in the drain line. This system shall also permit the recirculation of pump discharge back into the wet well for the purpose of scouring solids from the wet well and pumping them into the force main. The emergency pump around piping connections shall be accessible from grade. Submersible sewage pumping stations with a discharge head of 100 feet or greater must have an on-site manhole upstream of the wet well to serve as an emergency wet well for portable pump use. Care should be taken to locate this manhole, when required, out of traffic areas.

(d) Flowmetering

Dedicated pump discharge flowmetering and chart recording devices shall be provided for all custom built-in-place stations and those package stations designated by the City. Where dedicated flowmetering equipment is not provided, provisions shall be made for utilizing portable flowmetering devices. The City utilizes ultrasonic flowmetering instruments which normally require a location with limited influence of valves, bends and fittings. For the devices employed by the City, five upstream and three downstream pipe diameters of straight pipe are usually sufficient. Additional length of straight piping is desirable.

(e) Pumping Units

Sewage pumps shall be 4 inch minimum size. All sewage pumps shall rotate counterclockwise as viewed into the

impeller eye. Sewage pumps shall be centrifugal non-clog solids handling pumps capable of passing a 3 inch sphere. Pump motors shall operate on 460 volt, 3 phase, 60 cycle electrical service. Pump motor horsepower shall be sufficient to prevent motor overload under all possible conditions. Sewage pumps and motors shall be suitable for continuous duty.

(i) Submersible Sewage Pumps

Pump volute, impeller and motor housing shall be of cast iron construction. The pump volute casing and impeller shall be fitted with replaceable stainless steel wear rings to maintain sealing efficiency between the pump volute and impeller. The motor shaft shall be heat-treated high strength alloy steel or high strength stainless steel having a tapered end with keyway to receive the impeller. All nuts, bolts and screws shall be stainless steel. The motor shall be sealed from the pump by independent double mechanical seals. The upper mechanical seal shall run in an oil chamber and the lower mechanical seal shall run in the pumped liquid. All mating surfaces where watertight sealing is required shall be machined and fitted with a rubber O-ring. The machining of mating surfaces shall provide metal to metal bearing on sealing surfaces without crushing the O-ring.

(ii) Dry Well Sewage Pumps

Pumps shall be of the vertical biltogether design. Pump volute, impeller, support base, suction elbows, seal housing/motor adapter and motor housing shall be of cast iron construction. The pumps volute and impeller shall be fitted with replaceable stainless steel wear rings to maintain sealing efficiency between the pump volute and impeller. The motor adapter shall have jacking screws to permit adjustment of the wear ring clearances. The pump/motor shaft shall be stainless steel with straight fit impeller and with keyway. All nuts, bolts, and screws exposed to sewage shall be stainless steel. The pumps shall have double mechanical shaft seals, water lubricated. All mating

surfaces shall be machined and sealed with gaskets or rubber o-rings. Where rubber o-ring seals are used, metal mating surfaces shall provide metal to metal bearing without crushing the o-ring.

(f) Pump Starters and Controls

Sewage pumping stations must be suitable for unattended automatic operation. As a result, the pump starting and stopping must be affected by equipment that is direct, reliable and easily understood by operating personnel. Pump starters shall be single speed, full voltage, non-reversing type.

(g) Pump Removal

From time to time sewage pump removal is required for periodic maintenance or overhaul. Dedicated lifting devices for pump removal will be provided for custom built-in-place sewage pumping stations. A motorized trolley hoist positioned over pump access openings shall be furnished. Package sewage pumping stations will not have dedicated lifting devices. Pump removal will be accomplished by a truck mounted boom hoist positioned over access openings. Submersible sewage pumps shall feature stainless steel guide rails and automatic cast iron discharge connection elbow system permanently installed in the wet well. Package wet well/dry well sewage pumping stations shall be furnished with a sufficient number of lifting eyes in the dry well top slab which can be used to assist in safe positioning of the pumps under the dry well access tube for a direct lift.

(h) Gauges

Pressure gauges where required shall be direct reading 4-1/2 inch dial, 1/2 inch connection in accordance with City specifications.

(4) Emergency Station Operations

To ensure that utility power failures do not cause sewer system overflows, provisions to maintain sewage pump station operation with a standby power supply shall be made. The design engineer

shall evaluate the following methods of dealing with utility power failures and select the method most appropriate for the project.

(a) Dual Feed Power Supply

Dual feed power supply shall be provided for the station if available from the power company.

(b) On-Site Power Generation

Where dual feed power supply is not available from the power company, a diesel engine driven emergency electric generator shall be provided. The unit shall be sized to allow both pumps to operate at the same time. Automatic transfer switch shall be provided to switch to emergency power on a power failure or a drop in any phase voltage to 70 percent of line voltage. A 275 gallon minimum aboveground diesel oil tank shall be provided in the generator room for fuel storage.

(5) Miscellaneous

(a) Water System

Where water is available, a metered connection from the existing water system shall be made and water for the purposes of flushing and sewage pumping station washdown shall be provided. A 50 foot length of hose with spray nozzle, hose bib and interior backflow preventer shall be provided at a minimum. A water supply system shall be provided for all custom built-in-place sewage pumping stations. If there is no existing water supply system, a well and hydropneumatic tank shall be installed at custom built-in-place stations.

(b) Electrical Service

The electric service shall be 277/480V-3 phase - 4W. The service shall be sized to allow all station fixtures, equipment, and both pumps to operate together.

(c) Convenience Receptacles

120-volt, 1-phase receptacles with GFI shall be provided within the pump station buildings. One duplex outdoor

weatherproof outlet shall be provided for the odor control unit and one duplex weatherproof outlet shall be provided for portable tools, lights, etc.

A weatherproof 480-volt, 3-phase, 100-amp receptacle will be provided on the building wall exterior to allow use of a portable emergency pump.

(d) Portable Generator Connection

Pump station buildings shall have a through wall 4 inch diameter pipe sleeve with capped ends to permit the passage of temporary power cables. Power from a portable generator can be delivered to the automatic transfer switch at the emergency generator connection lugs for stations so equipped, or at the station main breaker if emergency generator is not provided.

(e) Coatings and Painting

In general, all exposed construction materials and equipment shall be field painted or have some other form of field applied protective coating. Stainless steel, aluminum, PVC, brick and factory finished items are excluded. Painting unfinished materials shall be in accordance with the specification. Paint and other coatings shall be utilized as necessary to prevent corrosion, extend wear or promote easy to clean surfaces. Paint and coating systems used at sewage pumping stations must exhibit superior durability.

(f) Testing

The installation of mechanical and electrical equipment in accordance with these design standards requires, upon completion and prior to final inspection, testing to insure the standards are met and to maintain quality control. Electrical testing procedures will apply to all electrical equipment. Vibration testing procedures will apply to all motor or engine-driven equipment. Load bank testing procedures will apply to all standby generators.

(g) Autodialer

All pump stations must be equipped with an autodialer with telephone service to allow for telemetry. A Raco

Verbatim shall be supplied at a minimum. Additional or substitute telemetry systems may be required as is deemed warranted by the City at the time of the design of the pump station.

(h) Final Inspection Checklist

Prior to sewage pumping station acceptance as part of the City of Brunswick Sewage System, a thorough inspection and operational check of the station is required in the presence of a representative of the City. A typical final inspection test procedure and checklist is attached to the specification. Each sewage pumping station design shall be submitted with an inspection test procedure and checklist tailored to the station.

d. Vibration

The pump station designer is directed to include vibration design and installation requirements in the Specifications.

4.0 CONTRACT DRAWINGS AND DOCUMENTS

4.1 Reports

For sewer mains larger than 8-inches, three copies of a preliminary report shall be submitted to the City. The report shall include a sketch of the preliminary layout and a summary of the design data.

4.2 Design Computations

a. Design engineers shall submit three copies of design data and calculations for all sewer projects. The computations shall be in ccordance with methods presented in this manual.

b. The design data and computations shall include: average, peak, inflow and infiltration, and future requirements.

c. Design computations for all special structures shall be submitted. Where information pertinent to design, such as borings, has been collected, this information shall be submitted to the City. The locations of borings shall be shown on the plan sheets, and the boring logs shall be included in the Contract Documents. In addition, the City reserves the right to require borings and geotechnical information.

4.3 Specifications

Contract specifications shall utilize the City of Brunswick Specifications or, in the absence of City Specifications, the Frederick County Specifications will apply.

4.4 Contract Drawings

4.4.1 Preparation

Sewer main Contract Drawings shall be prepared on drawings separate from drawings detailing the road design. Separate drawings shall be used for each street.

4.4.2 Plan

a. Scale: 1 inch = 50 feet.

b. Method of Indicating Location

Generally, sewer mains and structures shall be located in Plan by dimensions from property markers or other well defined physical features. However, in areas where physical features are not available, coordinates of structures and bearings of sewer mains based on the Maryland Coordinate System NAD 83/91 shall be used.

c. Fittings

A list of all fittings required shall be shown on each drawing.

d. Contract Drawings shall include the property line surveys and all lot dimensions of the land bordering sewer extensions and shall indicate the names of the present owners of such property with the recording reference number of the deed, lot numbers, house numbers, subdivision names and block numbers, as well as existing rights-of-way or easements. When rights-of-way must be obtained, a right-of-way drawing for each property shall be provided, accompanied by a written description of each right-of-way.

4.4.3 Profile

Profiles shall be shown for all sewer mains. Profile shall be on same sheet as the Plan.

a. Scale

Scale of all profiles shall be 1 inch = 50 feet horizontal; 1 inch = 5 feet vertical. Sewer main profiles on straight streets shall be shown to correct

scale. On curved streets, horizontal distances between structures shall be plotted, using length of street centerline between radial projections to structures. The true length between structures shall be shown by figures.

b. Road Grades

Approved established grades shall be obtained from the City. When such grades are not available, they shall be established by the design engineer and submitted to the City for approval.

The established grade (noted as top of curb or centerline) shall be shown. Where sewer main is located in present or proposed pavement or shoulders, the existing centerline grade of road shall be shown. Where sewer main is outside pavement or shoulders for a length greater than 50 feet, existing ground over sewer main shall be shown and labeled.

c. Sewer Main on Fill

Where sewer main is to be constructed on fill, a profile of the undisturbed earth (at sewer main location) shall be shown.

4.4.4 Pump Stations

Sufficient details, plan views and elevations shall be shown for all pump stations, including architectural, mechanical, civil or site, electrical and structural plans and details. The scale of elevations and details shall be 1/4" = 1'-0". Slightly larger or smaller scale views may be used if more appropriate. Site plans should be shown at 1" = 10' or 1" = 20' scale.

4.4.5 Grinder Pumps

Grinder Pump locations shall be clearly shown on the plan view, with a table or chart identifying the depth, type, size and other pertinent details. The plan view shall clearly shown the location of the electrical cables and alarms, breakers and appropriate details.

4.4.6 Other Utilities

Other existing and proposed utilities shall be shown accurately and clearly in Plan and Profile.

4.4.7 Location and Design Information

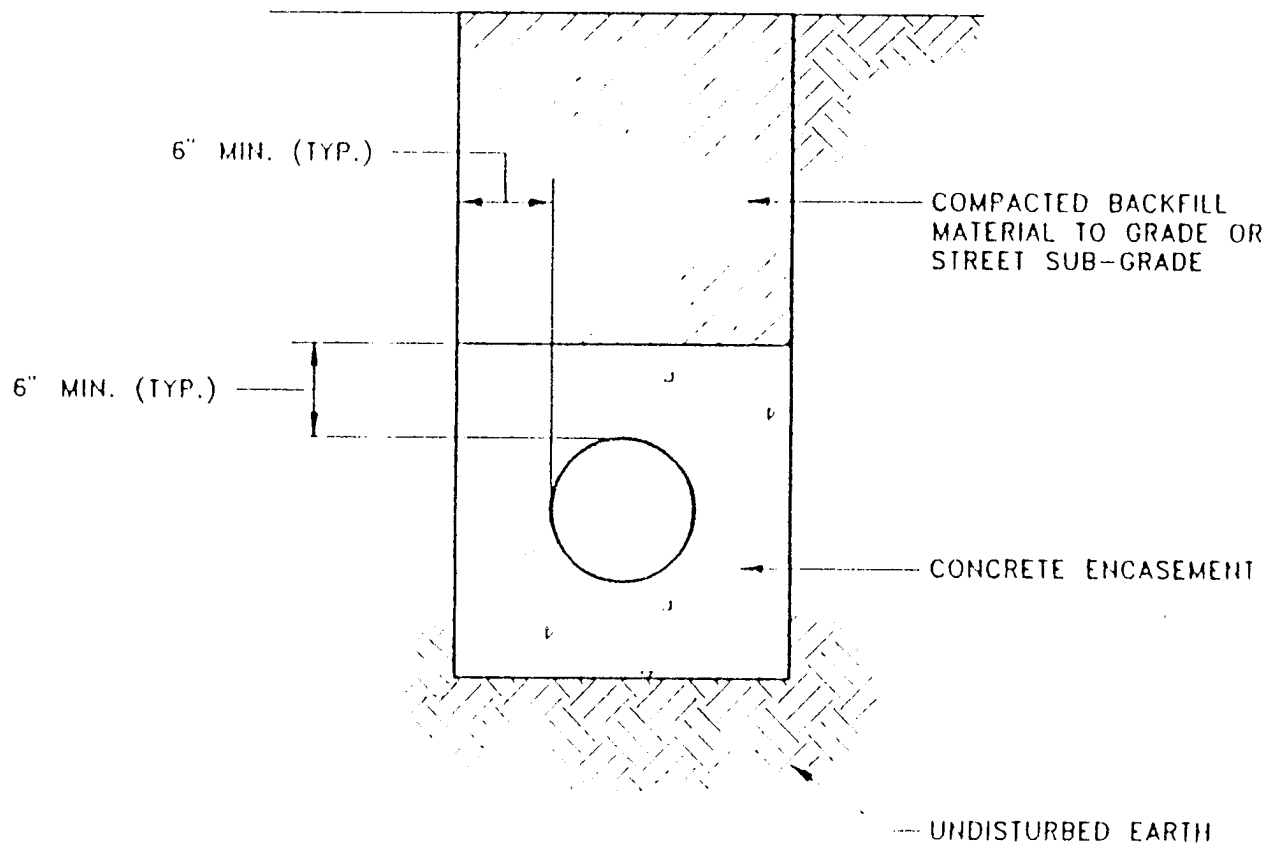
A Location Plan, showing well known streets, at a scale of 1 inch = 200 feet shall appear on the first drawing of each set of Contract Drawings. A schematic layout

of the proposed extensions to the sewer system and adjacent existing lines shall be shown.

4.4.8 Special Details

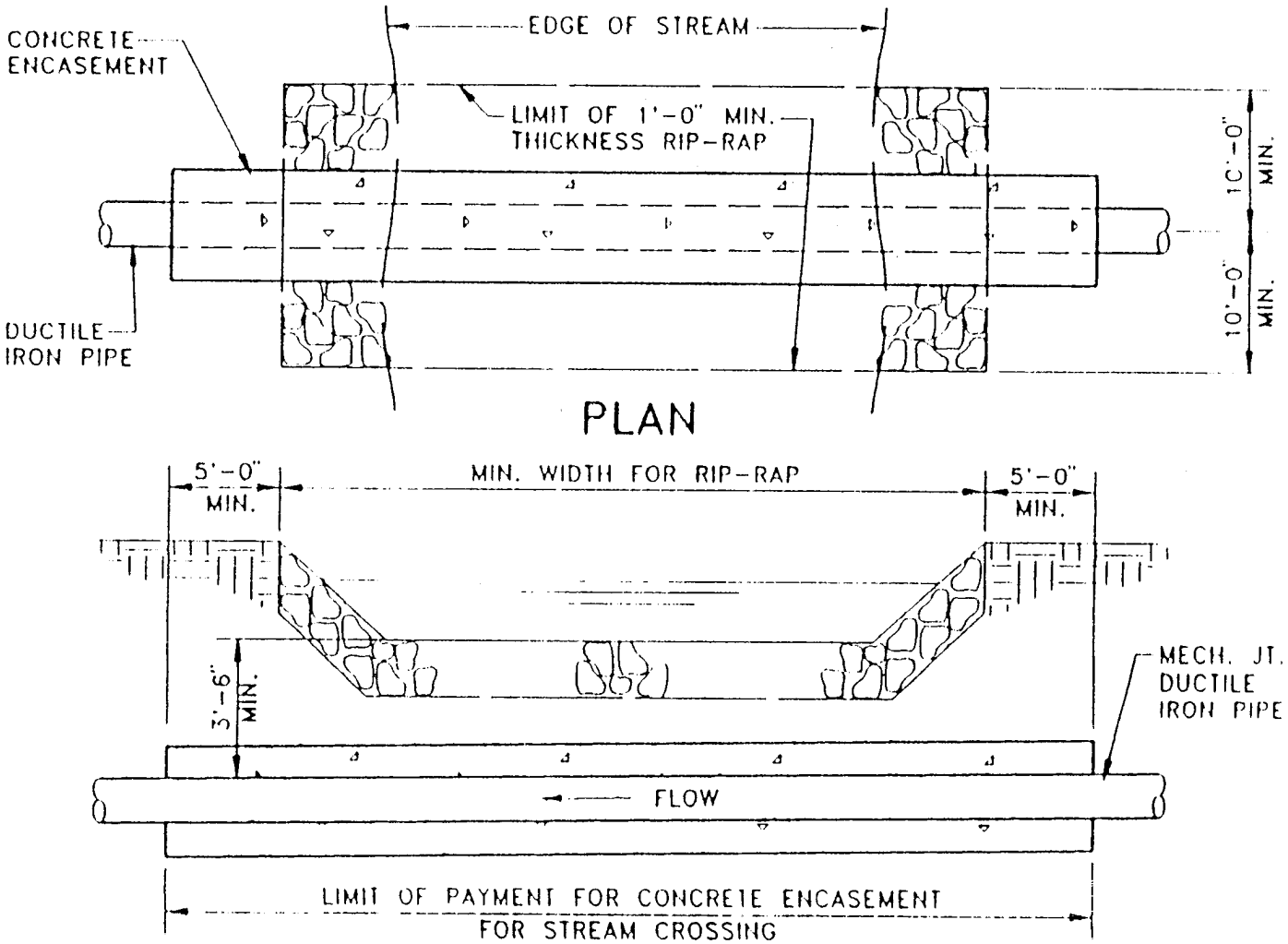
Structures of details not included in the Standard Details shall be detailed clearly on the Contract Drawings, preferably where the detail is located in Plan.

4.4.9 As-Built drawings are required to be submitted with the Request for Conditional Acceptance in addition to the Request for Final Acceptance for review and approval. Once approved, the appropriate number of the As-Built drawings on mylar plan sheets with the statement and Engineer's signature, as shown in the Appendix, and City Approval Block shall be submitted to City Hall prior to Final acceptance of the work by the City and on computer or GIS diskette in a format approved by the City Public Works, City Engineer, and the Office of Planning and Zoning.



CONCRETE ENCASEMENT DETAIL

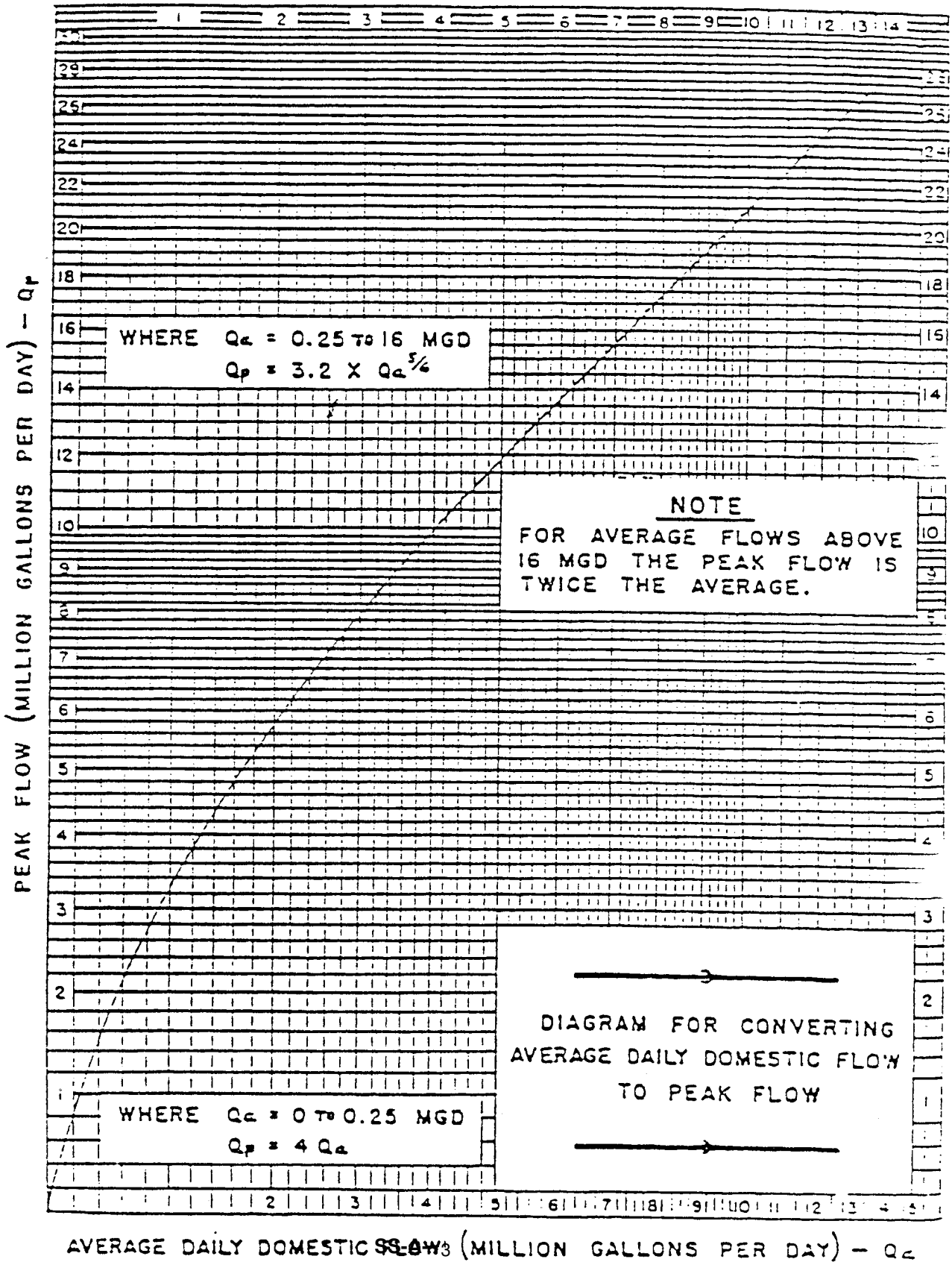
NO SCALE



STREAM CROSSING DETAIL

NO SCALE

APPENDIX A
PEAK FLOW CURVE
(from State of Maryland "Design Guidelines for Sewerage Facilities")



APPENDIX B

FLOW PROJECTIONS BASED UPON GALLONS PER PERSON PER DAY

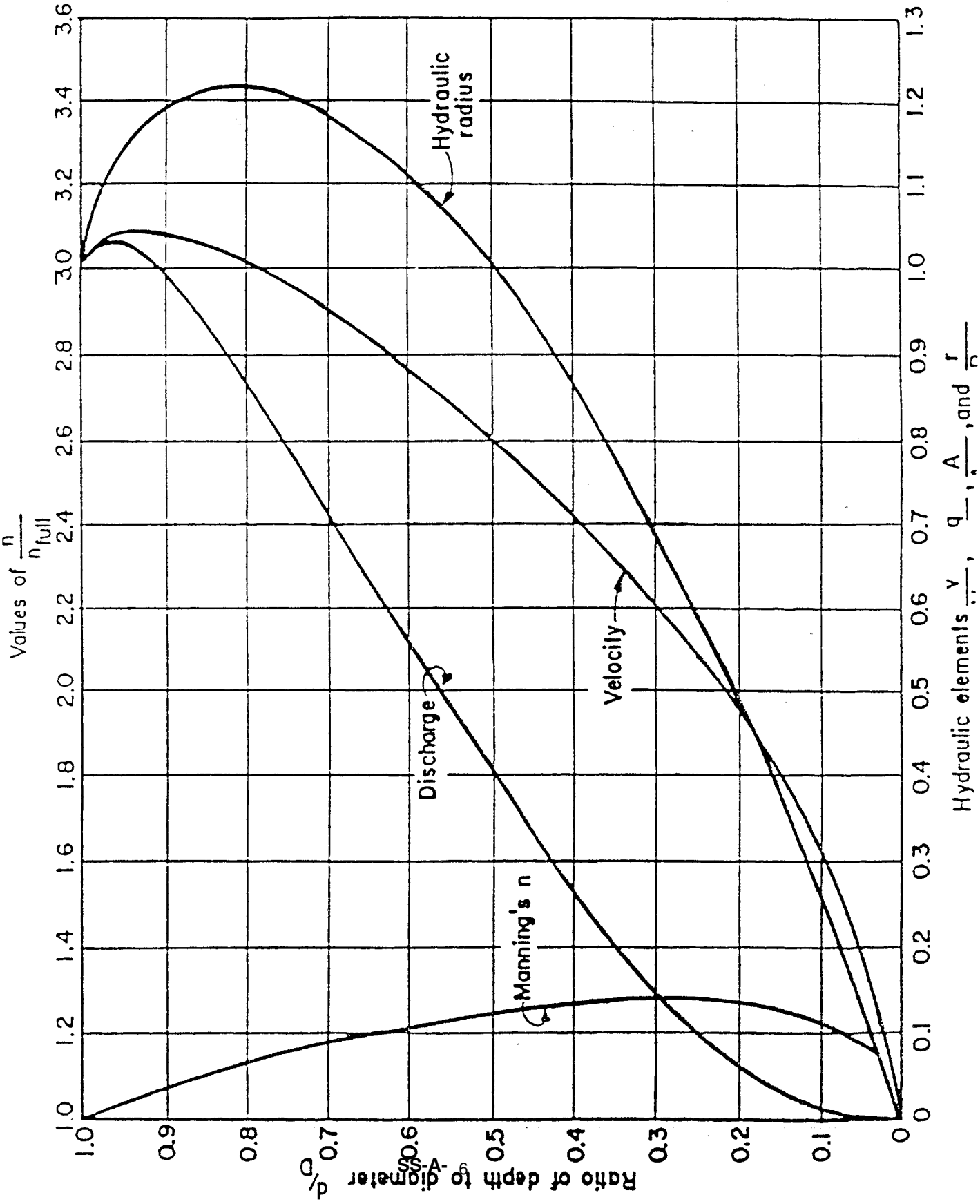
Type of Establishment	Gallons Per Person Per Day (Unless Otherwise Noted)
Cottages and small dwellings with seasonal occupancy	50
Country clubs (per resident member)	100
Country clubs (per non-resident member present)	25
Dwellings:	
Boarding houses	50
additional for non-resident boarders	10
Luxury residences and estates	150
Multiple family dwellings (apartments)	60
Rooming houses	40
Single family dwellings	75-100
Factories (gallons per person, per shift, exclusive of industrial wastes)	35
Hospitals (per bed space)	350
Hotels with private baths (2 persons per room)	60
Hotels without private baths	50
Institutions other than hospitals (per bed space)	125
Laundries, self-service (gallons per wash, i.e., per customer)	50
Mobile home parks (per space)	250
Motels with bath, toilet and kitchen wastes (per bed space)	50
Motels (per bed space)	40
Picnic Parks (toilet wastes only) (per picnicker)	5
Picnic Parks with bathhouses, showers and flush toilets	10
Restaurants (per seat)	25
Restaurants (toilet and kitchen wastes per patron)	10
Restaurants (kitchen wastes per meal served)	3
Restaurants, additional for bars and cocktail lounges	2
Schools:	
Boarding	100
Day, without gyms, cafeterias or showers	15
Day, with gyms, cafeteria and showers	25
Day, with cafeteria, but without gyms or showers	20
Service Stations (per vehicle served)	10
Swimming pools and bathhouses	10
Theaters:	
Movie (per auditorium seat)	1
Drive-in (per car space)	5
Travel Trailer Parks without individual water and sewer hook-ups (per space)	50
Travel Trailer Parks with individual water and sewer hook-ups (per space)	100
Workers:	
Construction (at semi-permanent camps)	50
Day, at schools and offices (per shift)	15

APPENDIX C

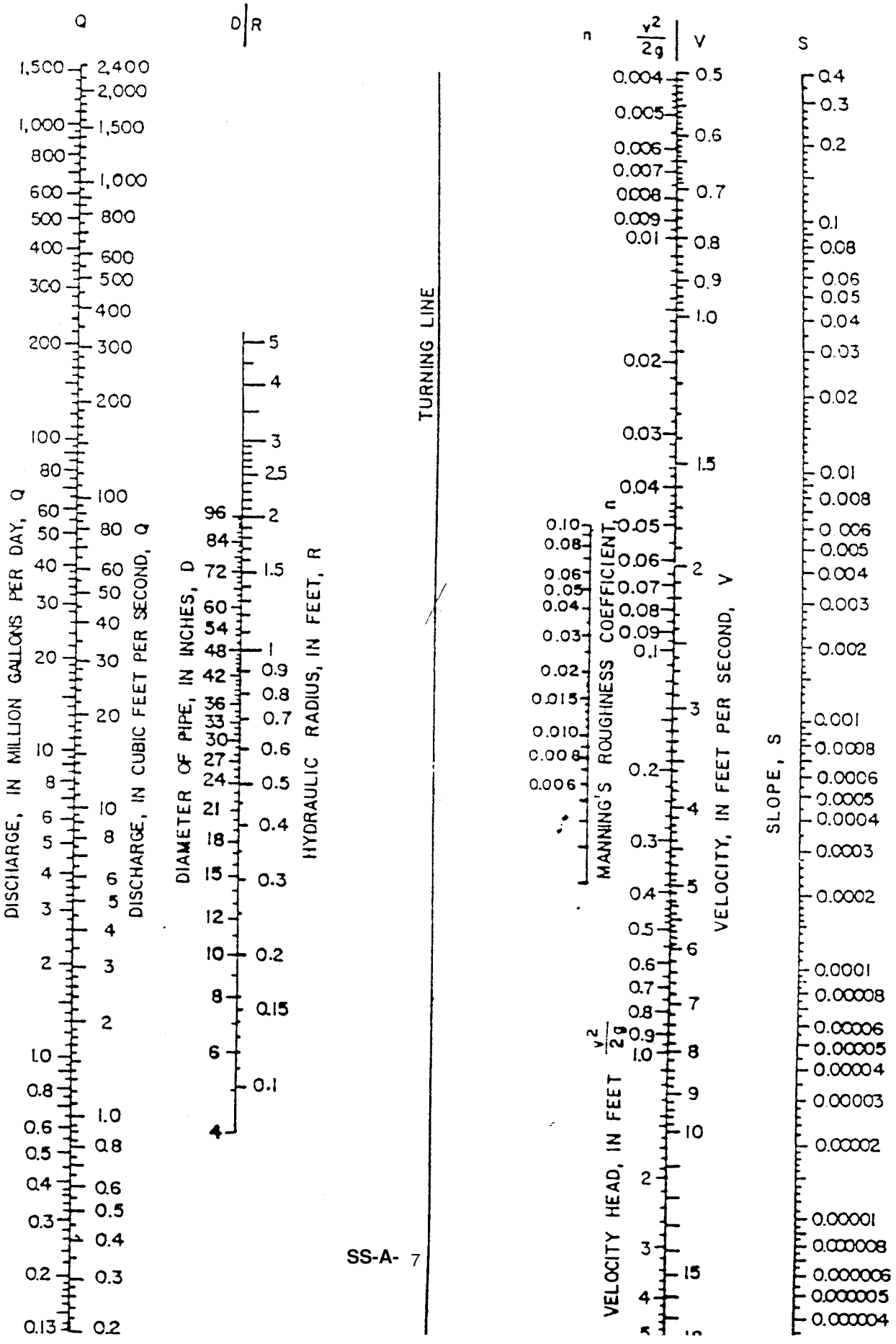
GUIDING FACTORS FOR FLOW PROJECTION RELATED WITH COMMERCIAL ESTABLISHMENTS, PUBLIC SERVICE BUILDINGS OR DWELLING UNITS

Office Buildings	Gross Sq. Ft. x 0.09 =		gpd
Medical Office Buildings	Gross Sq. Ft. x 0.62 =		gpd
Warehouses	Gross Sq. Ft. x 0.03 =		gpd
Retail Stores	Gross Sq. Ft. x 0.05 =		gpd
Supermarkets	Gross Sq. Ft. x 0.20 =		gpd
Drug Stores	Gross Sq. Ft. x 0.13 =		gpd
Beauty Salons	Gross Sq. Ft. x 0.35 =		gpd
Barber Shops	Gross Sq. Ft. x 0.20 =		gpd
Department Store with Lunch Counter	Gross Sq. Ft. x 0.08 =		gpd
Department Store without Lunch Counter	Gross Sq. Ft. x 0.04 =		gpd
Banks	Gross Sq. Ft. x 0.04 =		gpd
Service Stations	Gross Sq. Ft. x 0.18 =		gpd
Laundries & Cleaners	Gross Sq. Ft. x 0.31 =		gpd
Laundromats	Gross Sq. Ft. x 3.68 =		gpd
Car Wash without Wastewater Recirculation Equipment	Gross Sq. Ft. x 4.90 =		gpd
Hotels	Gross Sq. Ft. x 0.25 =		gpd
Motels	Gross Sq. Ft. x 0.23 =		gpd
Dry Goods Stores	Gross Sq. Ft. x 0.05 =		gpd
Shopping Centers	Gross Sq. Ft. x 0.18 =		gpd

APPENDIX D
HYDRAULIC ELEMENTS GRAPH



APPENDIX E
MANNING EQUATION NOMOGRAPH



APPENDIX F
FLOW TABULATION FORM

JOB NAME				DISTRICT	
PREPARED BY		DATE			
CHECKED BY		DATE			
SHEET ____ OF ____					

AREA SYMBOL		AREA ACRES			POP. DENSITY		POP.		AVG. DOMESTIC FLOW MGD		AVG. COMM. FLOW MGD		AVG. IND. FLOW MGD		PEAK DOM. COMM. FLOW MGD		PEAK IND. FLOW MGD		INFILTRATION MGD	DESIGN FLOW MGD		APPROX. GRADE %	TENTATIVE SIZE INCHES	VELOCITY FPS	
FROM 1	TO 2	DOM 3	COM 4	MIX 5	PRES 6	ULT. 7	PRES 8	ULT. 9	PRES 10	ULT. 10	PRES 12	ULT. 13	PRES 14	ULT. 15	PRES. 16	ULT. 17	PRES 18	ULT. 19	20	PRES 21	ULT. 22	23	24	PRES AVE 25	ULT PEAK 26
	SS-A-8																								

GEO-TECHNICAL REQUIREMENTS FOR UTILITY DESIGN AND CONSTRUCTION INSPECTION

PURPOSE

The following is intended to provide guidance to the engineer and contractor in their pursuit of the project and not to specifically dictate their activities.

DESIGN PHASE

Geotechnical services provided during water utilities design shall include the selection of boring and test pit locations, and the selection of sample types and intervals, the selection of field and laboratory test procedures, and the preparation of a geotechnical report. At a minimum, the report shall include the following:

1. Project overview.

2. Types of measures that will be needed to check stabilization of excavations and provide values of design parameters (lateral earth pressure distribution, allowable slopes).

3. Need for dewatering systems that may be needed and provide description of groundwater conditions over project limits of work.

4. Foundation preparation measures to be used.

5. Allowable bearing pressures, anticipated total and differential settlement, pipe bedding requirements, etc., to support design loads.

6. Backfill material characteristics required.

7. Estimated volumes of borrow.

8. The level of compaction needed to satisfy design criteria and methods of achieving this compaction through appropriate combinations of compaction equipment, water contents, and lift thicknesses.

9. Pavement design considerations.

10. Pavement reconstruction considerations - address need for road reconstruction around excavations.

11. The basis that will be used for field evaluation of material suitability, adequacy of compaction, acceptability of shoring, etc.

12. The potential sources and magnitudes of uncertainty in geotechnical conditions.

13. Guideline construction specification with respect to geotechnical requirements.

14. Potential for encountering sink holes and mitigation measures for avoidance.

15. Soil boring logs within area of construction and stormwater management facilities.

16. Impact on nearby wells and springs and mitigation measures.

CONSTRUCTION PHASE - FIELD IMPLEMENTATION OF GEOTECHNICAL REPORT RECOMMENDATIONS

Implementation of geotechnical report recommendations and design requirements is critical to satisfactory completion of the project. The following guidelines are to be followed by the project inspector.

1. The design phase geotechnical engineer should be involved during construction. (Depending on the size of the project, this involvement could range from telephone consultation to on-site inspections. However, geotechnical expertise should be available during construction.)

2. A qualified testing laboratory should be engaged.

3. The geotechnical report prepared during design should be provided to the inspector prior to construction. Both the inspector's office and field personnel should be familiar with all aspects of the report, including, but not necessarily limited to the following:

    a. Existing conditions.
    b. Feasibility of using materials from trench for backfill.
    c. Appropriate compaction methods for excavated materials.
    d. Procedures for selecting and approving borrow sites.
    e. Appropriate compaction methods for borrow materials.
    f. Recommendations for when select materials should be used.
    g. Appropriate methods for compaction of select materials.
    h. Appropriate methods for monitoring 'c', 'e', and 'g' above:
        (1) Sampling.
        (2) Laboratory testing.
        (3) Field testing.

4. In consultation with the design geotechnical consultant, the resident inspector should develop a written plan for implementation of the recommendations of the geotechnical report. This plan should include the following:

    a. Identification of the person responsible for insuring adherence to geotechnical report recommendations in the field. Because immediate field decisions are usually required at some time during construction, this person should be well grounded in the subject of backfill materials, methods and compaction, and at least knowledgeable enough to recognize field conditions that do not conform with the geotechnical report and to seek necessary assistance.

b. Establishment of general criteria for use by the field representative in meeting the requirements of the geotechnical report:
   (1) Frequency of standard Proctor determinations.
   (2) Frequency of soil density determinations.
   (3) Criteria for using visual characteristics and soil consistency for spot determinations of backfill material suitability without consulting geotechnical experts.
   (4) Criteria for using visual characteristics and soil consistency for spot determinations of compaction suitability without soil density determinations.

c. Establishment of procedures for detailed record-keeping using a daily inspection report form. This form would require that each of the following be addressed:
   (1) Conditions encountered.
   (2) Help sought from supervisors, geotechnical engineer, etc.
   (3) Location of field tests.
   (4) Weather conditions.
   (5) Notations on visual and manual observations.
   (6) Exceptions to geotechnical report recommendations (field decisions).